# PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

## PCT

### NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Commissioner
US Department of Commerce
United States Patent and Trademark
Office, PCT
2011 South Clark Place Room
CP2/5C24
Arlington, VA 22202
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

| | |
|---|---|
| **Date of mailing** (day/month/year)<br>18 January 2001 (18.01.01) | |
| **International application No.**<br>PCT/US00/04765 | **Applicant's or agent's file reference** |
| **International filing date** (day/month/year)<br>24 February 2000 (24.02.00) | **Priority date** (day/month/year)<br>24 February 1999 (24.02.99) |
| **Applicant**<br>KITHIL, Philip, W. | |

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International Preliminary Examining Authority on:

22 September 2000 (22.09.00)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

| | |
|---|---|
| **The International Bureau of WIPO**<br>**34, chemin des Colombettes**<br>**1211 Geneva 20, Switzerland** | Authorized officer<br>S. Mafla |
| Facsimile No.: (41-22) 740.14.35 | Telephone No.: (41-22) 338.83.38 |

PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 : B60R

A2

(11) International Publication Number: WO 00/50261

(43) International Publication Date: 31 August 2000 (31.08.00)

(21) International Application Number: PCT/US00/04765

(22) International Filing Date: 24 February 2000 (24.02.00)

(30) Priority Data:

| | | |
|---|---|---|
| 60/121,653 | 24 February 1999 (24.02.99) | US |
| 60/138,139 | 8 June 1999 (08.06.99) | US |

(71) Applicant *(for all designated States except US)*: ADVANCED SAFETY CONCEPTS, INC. [US/US]; Suite E–12, 1570 Pacheco Street, Santa Fe, NM 87505 (US).

(72) Inventor; and

(75) Inventor/Applicant *(for US only)*: KITHIL, Philip, W. [US/US]; 1274 Vallecito Drive, Santa Fe, NM 87501 (US).

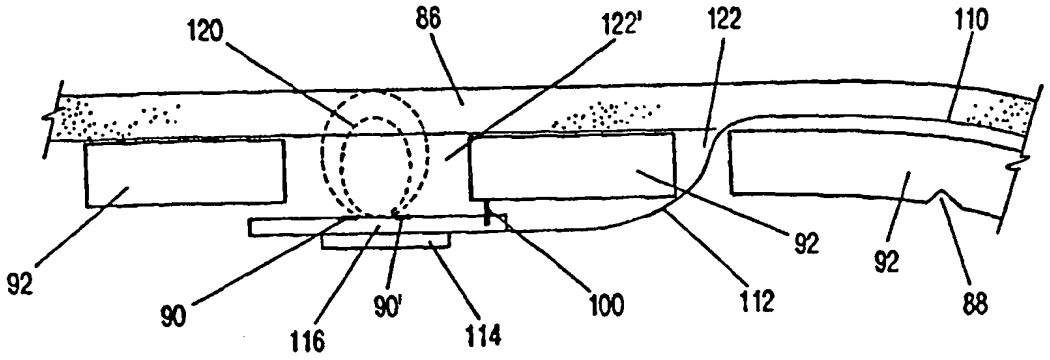
(74) Agent: MYERS, Jeffrey, D.; Peacock, Myers & Adams, P.O. Box 26927, Albuquerque, NM 87125–6927 (US).

(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

**Published**

*Without international search report and to be republished upon receipt of that report.*

(54) Title: CAPACITIVE SENSORS FOR VEHICULAR ENVIRONMENTS




(57) Abstract

Capacitive sensors used to detect force upon a transparency product for detecting and discriminating crash characteristics of a vehicle, as well as capacitive sensors used in conjunction with a conductive panel functioning as an airbag cover and ground plane for the capacitive sensors. The capacitive sensors are made up of electrodes, of which one may be a conductive coating. The capacitive sensors can be arranged upon a substrate and can include a reference sensor. Long term effects of temperature upon sensor output are compensated for with an algorithm comparing constant desired sensor output to low frequency drift due to temperature effects. Moisture upon a transparency product is distinguished from a nearby object due to the capacitance sensed. A sleep detection algorithm detects when a vehicle operator is drowsy. A capacitive sensor array having a nested circle sensor and L–shaped sensors, along with a dummy sensor is used in a sunroof–equipped vehicle for sensing occupant head position.

*FOR THE PURPOSES OF INFORMATION ONLY*

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| AL | Albania | ES | Spain | LS | Lesotho | SI | Slovenia |
| AM | Armenia | FI | Finland | LT | Lithuania | SK | Slovakia |
| AT | Austria | FR | France | LU | Luxembourg | SN | Senegal |
| AU | Australia | GA | Gabon | LV | Latvia | SZ | Swaziland |
| AZ | Azerbaijan | GB | United Kingdom | MC | Monaco | TD | Chad |
| BA | Bosnia and Herzegovina | GE | Georgia | MD | Republic of Moldova | TG | Togo |
| BB | Barbados | GH | Ghana | MG | Madagascar | TJ | Tajikistan |
| BE | Belgium | GN | Guinea | MK | The former Yugoslav Republic of Macedonia | TM | Turkmenistan |
| BF | Burkina Faso | GR | Greece | | | TR | Turkey |
| BG | Bulgaria | HU | Hungary | ML | Mali | TT | Trinidad and Tobago |
| BJ | Benin | IE | Ireland | MN | Mongolia | UA | Ukraine |
| BR | Brazil | IL | Israel | MR | Mauritania | UG | Uganda |
| BY | Belarus | IS | Iceland | MW | Malawi | US | United States of America |
| CA | Canada | IT | Italy | MX | Mexico | UZ | Uzbekistan |
| CF | Central African Republic | JP | Japan | NE | Niger | VN | Viet Nam |
| CG | Congo | KE | Kenya | NL | Netherlands | YU | Yugoslavia |
| CH | Switzerland | KG | Kyrgyzstan | NO | Norway | ZW | Zimbabwe |
| CI | Côte d'Ivoire | KP | Democratic People's Republic of Korea | NZ | New Zealand | | |
| CM | Cameroon | | | PL | Poland | | |
| CN | China | KR | Republic of Korea | PT | Portugal | | |
| CU | Cuba | KZ | Kazakstan | RO | Romania | | |
| CZ | Czech Republic | LC | Saint Lucia | RU | Russian Federation | | |
| DE | Germany | LI | Liechtenstein | SD | Sudan | | |
| DK | Denmark | LK | Sri Lanka | SE | Sweden | | |
| EE | Estonia | LR | Liberia | SG | Singapore | | |

CLAIMS

What is claimed is:

1. A force detecting capacitive sensor comprising at least two electrodes integral with a transparency product, and optionally wherein at least two of said at least two electrodes are parallel with one another, and optionally wherein at least two of said at least two electrodes are nonparallel with one another, and preferably wherein said transparency product is glass, and more preferably wherein said transparency product is a vehicle windshield.

2. The sensor of claim 1 wherein at least one of said at least two electrodes comprises a conductive coating integral with said transparency product.

3. A system for detecting force which imparts momentary bending to a transparency product, said system comprised of at least one force detecting capacitive sensor integral with a transparency product, preferably wherein said at least one sensor is configured for discriminating different vehicle crash characteristics, and preferably wherein said system further comprises a vehicle occupant protection system comprised of at least one occupant restraint device which operates in conjunction with said system for detecting force.

4. A system for detecting a visibility condition of a transparency product, said system comprising at least one capacitive sensor integral with the transparency product, and preferably wherein said system distinguishes between a visibility condition and an object in proximity to the transparency product, and preferably wherein said system operates in conjunction with a vehicle occupant protection system to distinguish between a vehicle occupant in proximity to the transparency product and condensed moisture on the transparency product, and preferably wherein said system further initiates a response to modify the visibility condition.

5. A method of compensating for the long-term effects of temperature on a sensing system, the method comprising the steps of:

a) determining the constant desired sensor output;

b) determining low frequency shifts due to temperature effects;

c) comparing the constant desired sensor output to the low frequency shifts due to temperature effects; and

d) employing a compensation algorithm to account for the difference.

6. A vehicle occupant detecting capacitive sensor in combination with a conductive panel functioning as a vehicle airbag door and ground plane for said capacitive sensor, and preferably further comprising additional capacitive sensors, all of said capacitive sensors fabricated on a substrate material adjacent said conductive panel, and preferably wherein said capacitive sensors are each assigned to at least one triangle for discriminating occupant proximity and providing data to an airbag controller, and preferably wherein said capacitive sensors are circular.

7. A method of configuring a capacitive sensor and a reference sensor on a dielectric substrate, the method comprising the steps of:

a) fabricating a reference sensor and a capacitive sensor on a substrate;

b) placing a monolithic ground on a reverse side of the substrate;

c) attaching a printed circuit board to a deleted portion of the monolithic ground;

d) connecting the reference sensor to electronic parts on the printed circuit board; and

e) compensating for changes in capacitive sensor output which are not related to proximity of a vehicle occupant by comparing the capacitive sensor output to the reference sensor output.

8. A method of detecting head motion indications of a drowsy vehicle operator, the method comprising the steps of:

a) representing the drowsy vehicle operator's head motion with a four-dimensional feature vector;

b) training a feature detection network;

c) utilizing a sleep detector to detect head motion that does not look like an alert operator's head motion and does look like a feature associated with a sleep nod;

d) customizing the sleep detector for individual vehicle operators; and

e) identifying the operator of a vehicle and modifying sleep detector parameters based on historical data attributable to the identified operator.

9. A capacitive occupant sensing system for a sunroof-equipped vehicle to monitor an occupant's head position, said system comprising a nested circle capacitive sensor, and at least one L-shaped capacitive sensor adjacent said nested circle capacitive sensor, wherein said nested circle capacitive sensor and said at least one L-shaped capacitive sensor are located adjacent the sunroof, and optionally further comprising a dummy sensor located on the opposite side of the sunroof from said nested circle capacitive sensor and said at least one L-shaped capacitive sensor.

10. A method of sensing an occupant's head position in a sunroof-equipped vehicle with a dummy sensor and a nested circle capacitive sensor array, the method comprising the steps of:

a) positioning a dummy sensor on an opposite side of the sunroof from the nested circle capacitive sensor array adjacent the sunroof;

b) deriving a composite head position from the dummy sensor head position and the triangulated head position from the nested circle capacitive sensor array;

c) identifying the operator by comparing the head coordinates of the operator to historical data attributable to the identified operator; and

d) updating parameters which identify non-impairment conditions of the operator.